AF/ 1765
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: David Mui et al.

Appln No.: 09/905,172

Filed: July 13, 2001

Title: ETCH PATTERN DEFINITION USING A CVD ORGANIC LAYER AS AN ANTI-REFLECTION COATING AND HARDMASK

Art Unit: 1765

Examiner: Deo, Duy Vu Nguy

Docket No.: 004227 USA02/ETCH/SILICON/JB1

Mail Stop Appeal Brief-Patents
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF UNDER 37 C.F.R. §1.192

Sir:

As set forth in the Notice of Appeal filed by first-class mail on October 13, 2004, Appellants hereby appeals the final decision of the Examiner in the above-identified application rejecting claims 8-11 and 13-40, which are all of the pending claims in the application. Appellant respectfully requests that the Board of Patent Appeals and Interferences reverse the Examiner's rejection of the claimed subject matter.

This Appeal Brief is filed in triplicate as required.

I. REAL PARTY IN INTEREST

Applied Materials, Inc. is the assignee of the present invention and the real party in interest.

II. RELATED APPEALS AND INTERFERENCES

No other appeals or interferences are known to Appellant, Appellant's legal representative, or the assignees, which will directly affect, be directly affected by, or have a bearing on the Board's decision in the pending appeal. **[Correct?]**

III. STATUS OF CLAIMS

The presently pending claims are provided in the attached Appendix.

Claims 8-11, 13, 15-21 and 27-29 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over Huang US 6,171,940 combined with Hasegawa et al. US 6,452,274 (Hasegawa).

Claims 22-24 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over Huang and Hasegawa in view of Tsai et al. US 6,083,815 (Tsai).

Claims 25 and 26 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over Huang and Hasegawa in view of Lou US 6,200,881.

Claims 30, 31, 33 and 34 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over Huang and Hasegawa in view of Chapman US 5,976,769.

Claims 14, 32 and 35-40 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over Huang and Hasegawa in view of Cheng et al. US 5,873,984 (Cheng) or Cheng together with Chapman.

IV. STATUS OF AMENDMENTS

A Final Office Action was mailed on April 13, 2004, rejecting Claims 8-11 and 13-40. A Response was filed subsequent to the Final Office Action on June 14, 2004, and in an Advisory Action mailed on July 2, 2004, the Examiner indicated that the request for reconsideration was considered but did not place the application in condition for allowance. A Notice of Appeal was filed by first-class mail on October 13, 2004, and

received by the Patent and Trademark Office on October 18, 2004. The claims have not been amended after final rejection.

V. SUMMARY OF INVENTION

One embodiment of the invention is a method of forming a multilayer, antireflective hard mask structure. The method comprises providing a substrate structure, e.g., a silicon wafer, then depositing a CVD organic layer by a plasma enhanced chemical vapor deposition (PECVD) process using a feed stream that comprises a hydrocarbon species, e.g., propylene, which results in a chemical vapor deposition (CVD) layer comprising both carbon and hydrogen. A dielectric layer, e.g., silicon oxynitride, is then deposited over the CVD organic layer, and a patterned organic photoresist layer is provided over the dielectric layer.

It should be noted that the substrate structure itself may comprise multiple layers, e.g., doped polycrystalline silicon/silicon oxide/single crystal silicon.

Using plasma etching, the dielectric layer is etched through apertures in the patterned photoresist layer until apertures are formed in the dielectric layer, and in a second plasma etching step, the CVD organic layer is etched through the resulting apertures in the dielectric layer. Thus, apertures are formed in the CVD organic layer.

A second embodiment of the invention is a method for trimming a mask feature. The method comprises providing one or more mask features on a substrate structure. Each mask feature comprises a CVD organic layer comprising carbon and hydrogen that has been deposited on the substrate structure by a PECVD process using a feed stream that comprises a hydrocarbon species and a dielectric layer disposed over the CVD organic layer. The dielectric layer is disposed over the CVD organic layer such that sidewall portions of the CVD organic layer are exposed. The sidewall portions of the CVD organic layer are etched by means of a plasma etching process such that the width of the one or more mask features is reduced at the substrate.

The advantages of the present invention are the following.

A structure is provided that has both antireflective properties and highly effective hard mask properties.

A masking structure is provided the formation of which requires only a very thin photoresist layer resulting in improved pattern resolution relative to prior art masking structures.

The masking structure provided can be effectively trimmed to decrease the critical dimensions of the feature(s) being etched.

The CVD organic layer can be trimmed with a dielectric antireflective coating or thin silicon oxide layer as the mask to achieve relatively small critical dimensions of the feature(s) being etched.

The masking structure provided by the invention can be easily removed from the etched substrate.

VI. ISSUES

Would the appealed claims have been obvious to one of ordinary skill in the art, at the time the invention was made, from the combined teachings of the prior art references relied on by the examiner?

VII. GROUPING OF CLAIMS

Within each group of claims subject to rejection over different combinations of references, the claims have not been argued separately.

VIII. ARGUMENT

The following legal authorities are relied on in the following argument in the order in which they are relied on.

In re Baird, 16 F.3d 380, 29 USPQ2d 1550 (Fed. Cir. 1994)

Bausch & Lomb, Inc. v. Barns-Hind Hydrocurve, 796 F.2d 443, 449, 230 USPQ 416, 420 (Fed. Cir. 1986)

W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied,* 469 U.S. 851 (1984)

MPEP §2143.02.

In re Jones, 958 F.2d 347, 351, 21 USPQ2d 1941, 1943-44 Fed. Cir.1992)

In re Fine, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1598-99 (Fed. Cir.1988)

MPEP 2143.01, second subheading.

In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir.1990)

In re Rouffet, 149 F.3d 1350, 47 U.S.P.Q.2d 1453, 1458 (Fed. Cir.1998)

MPEP 2143.01, final section.

In re Grasselli, 713 F.2d 731, 218 USPQ 769, 779-80 (Fed. Cir. 1983)

In re Ratti, 270 F.2d 810, 813, 123 USPQ 349, 352 (Fed. Cir. 1959)

In re Gordon, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984)

In re Tomlinson, 363 F.2d 928, 931, 150 U.S. P.Q. 623, 626 (CCPA 1966)

Akzo N.V. v. U.S. International Trade Commission, 808 F.2d1471, 1480-81, 1 USPQ2d 1241, 1246 (Fed. Cir. 1986), *cert. denied*, 482 U.S. 909 (1987)

Loctite Corp. v. Ultraseal Ltd., 781 F.2d 861, 874, 228 USPQ 90, 99 (Fed. Cir. 1985).

MPEP 2142, second paragraph.

The references:

Huang describes a semiconductor device and method of formation thereof. The device has a semiconductor substrate, an insulating layer, which may be organic, thereon, a dielectric layer thereon and a patterned photoresist thereon. The insulating layer is not described as comprising carbon and hydrogen and is not deposited by CVD. In fact there is no disclosure of any specific organic material.

Hasegawa discloses a semiconductor device that comprises a substrate (e.g., silicon), an insulating layer (e.g., silicon oxide), a dielectric organic layer and an interconnection layer in contact with the insulating layer and the dielectric layer, which may be organic.

The insulating layer may be carbon, in which case it may be deposited by CVD: see column 9, lines 4-12, but when it is an organic polymer it is deposited by a spin coating method. *Id.*

Tsai, Lou, Chapman and Cheng have been relied on only for limitations of certain dependent claims. Those references disclose the limitations relied on in various semiconductor devices and their manufacture, not necessarily relevant to the process of the appealed claims. In view of the fatal defects in the basic rejection, however, those

references shall not here be discussed at great length, but they will be referred to in the arguments

A. <u>Rejection of Claims 8-11, 13, 15-21 and 27-29 under 35 U.S.C. 103(a)</u>

The errors in the rejection of claims 8-11, 13, 15-21 and 27-29 are sufficiently clear that it is believed they vitiate all of the rejections set forth above.

As acknowledged by the examiner, Huang does not disclose a CVD layer comprising hydrogen and carbon over the substrate structure. The examiner relies on Hasegawa to supply the missing limitation. However, Hasegawa actually teaches away from the limitation and its concept.

Hasegawa exhibits an awareness of the CVD process. However, it is disclosed as being useful for the formation of an "amorphous carbon" layer, and nothing is stated concerning the hydrogen content, if any, of the layer. With respect to polymers, which conceivably could contain both carbon and hydrogen, only spin coating is disclosed. See column 9, lines 4-12. Such a disclosure of knowledge of a process and its almost explicit direction not to use it for the one relevant purpose constitutes the type of "leading away" that has been held to be the antithesis of the suggestion required to make a *prima facie* case of obviousness. In re Baird, 16 F.3d 380, 29 USPQ2d 1550 (Fed. Cir. 1994), Bausch & Lomb, Inc. v. Barns-Hind Hydrocurve, 796 F.2d 443, 449, 230 USPQ 416, 420 (Fed. Cir. 1986), W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied,* 469 U.S. 851 (1984).

Moreover, even if Hasegawa disclosed that for which the examiner relies on it, its combination with Huang to render the appealed claims obvious would involve the use of undue hindsight.

In order to establish a *prima facie* case of obviousness under 35 U.S.C. 103, (a) there must be some suggestion or motivation to modify/combine the references of record, and (b) there must be a reasonable expectation of success. See MPEP §2143.02 and the cases cited therein. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Jones, 958 F.2d 347, 351, 21 USPQ2d 1941, 1943-44 (Fed. Cir. 1992), In re Fine, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1598-99 (Fed. Cir. 1988). The mere

fact that references *can* be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination or modification. MPEP 2143.01, second subheading (emphasis added) (citing *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir.1990)).

Appealed independent claims 8, 17, 27 and 30 require a mask structure that contains a CVD organic layer which comprises carbon and hydrogen. The CVD organic layer is deposited over a substrate structure by a PECVD process using a feed stream that comprises a hydrocarbon species.

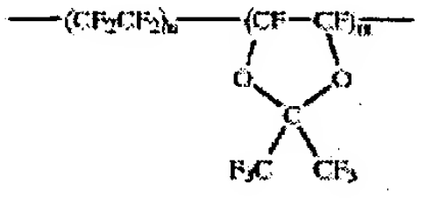
Such a mask structure is neither disclosed nor suggested by Huang, which merely refers to an "organic material layer having low dielectric constant" which is used for a purpose "analogous to that of a hard mask." See, e.g., col. 1, lines 49-51.

Recognizing this, the examiner turns to Hasegawa, arguing that: "Hasegawa describes a method for forming an organic low dielectric layer by PECVD and using materials such as fluorinated ethylene propylene. This would form an organic layer comprising carbon and hydrogen....It would have been obvious for one skill in the art to form the organic low dielectric layer in light of Hasegawa because Hasegawa further teaches [a] method that is silent in Huang to form an organic low dielectric layer with a reasonable expectation of success." As explained above, Hasegawa does not teach the use of PECVD to form an organic layer containing carbon and hydrogen. Additionally, the examiner has taken the position that the silence in Huang with respect to the composition of the organic layer constitutes motivation to use *any* organic layer having low dielectric constant, which is formed using *any* technique, for *any* purpose.

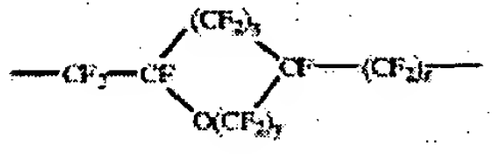
However, that is not the legal standard that is to be applied under 35 U.S.C. 103(a). Instead, "the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed." See, for example, *In re Rouffet*, 149 F.3d 1350, 47 U.S.P.Q.2d 1453, 1458 (Fed. Cir.1998). Such reasons have not been provided here by the examiner

For example, the examiner cites Hasegawa because it describes a low dielectric layer (col. 3, line 20), which is preferably selected from an organic layer comprising: cyclic fluororesin, polytetrafluoroethylene, a ***fluorinated ethylene propylene***, a

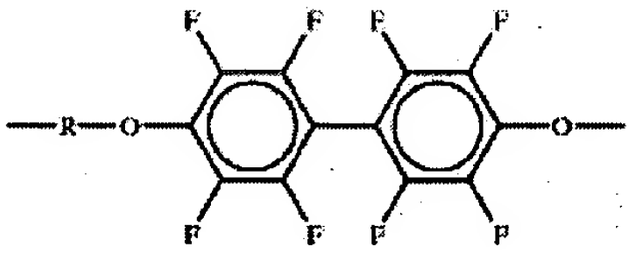
copolymer of tetrafluoroethylene and perfluoroalkoxyethylene, polyfluorovinylidene, polytrifluorochloroethylene, a fluoroaryl ether resin, polyfluoroimide, benzocyclobutene (BCB) polymer, polyimide, amorphous carbon, a monomethyltrihydroxysilane (organic SOG) condensate, a polymer having a repeating structural unit in its molecule of:



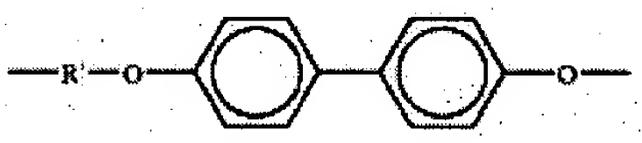
, a polymer having a repeating structural unit in its molecule of



, a polymer having a repeating structural unit in its molecule of



, a polymer having a repeating structural unit in its molecule of



, and materials available commercially under the brand names Amorphous Teflon, CYTOP (phonetic), and Flare.

The Office Action, however, does not explain why one of ordinary skill in the art would be motivated to select one of these particular materials, one which contains both carbon and hydrogen, for use in Huang, as opposed to the myriad other low dielectric organic layers known in the art.

Indeed, it is noted that the dielectric layers in Hasegawa are not ***masking*** layers, which are used in processing a substrate structure and then removed, but rather are ***interlayer insulating layers***, which are found within the multilayer interconnect structure of the finished device. See, e.g., Hasegawa Abstract and col. 1, lines 7-12. Because the layers of Huang and Hasegawa are employed in capacities that are completely unrelated to one another, it is respectfully submitted that one of ordinary skill in the art would be extremely unlikely to select the materials taught in Hasegawa for use in Huang, absent the hindsight gained from the present application. With respect to references teaching opposite purposes, see MPEP 2143.01, final section, In re Grasselli, 713 F.2d 731, 218 USPQ 769, 779-80 (Fed. Cir. 1983), In re Ratti, 270 F.2d 810, 813, 123 USPQ 349, 352

(Fed. Cir. 1959). With respect to undue hindsight see the authorities cited below, third paragraph from end of the discussion of this rejection.

Nor has the examiner convincingly explained why one would be motivated to use a PECVD process to form polymeric layers as opposed to other well known processes. In this connection, the examiner refers to the portion of Hasegawa from col. 8, line 65, to col. 9, line 11. However, careful review of this portion of Hasegawa reveals that it teaches the formation of polymer layers, such as those containing fluorinated ethylene propylene, by spin coating techniques, rather than by PECVD in a manner which leads to a direct teaching away from the appealed claims, as discussed above

In this regard, particularly with the aid of hindsight, it is noted that the art will frequently appear combinable or modifiable in a manner that will yield the claimed invention. However, this in and of itself will not make the resultant modification obvious. The art must still suggest the desirability of the modification. See *In re Gordon*, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984) ("The mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification."). See also, In re Jones, *supra,* In re Fine, *supra.* The examiner has failed to meet that burden.

Moreover, one skilled in the art would not have had a reasonable expectation for success in using the "low dielectric layer" materials taught in Hasegawa as an "organic material layer having low dielectric constant" in Huang. The fact that a material may be useful as an interlayer insulating material within a multilayer interconnect structure would by no means provide a reasonable expectation that the same material can be successfully employed as a masking layer. See in re Grasselli, *supra*, and In re Ratti, *supra.*

In essence, the examiner is suggesting that it would be obvious to try to use the "low dielectric layer" interlayer insulating layers taught in Hasegawa as an "organic material layer having low dielectric constant" masking layer as taught in Huang. However, permitting patentability determinations based on an "obvious to try" test "would not only be contrary to statute but result in marked deterioration of the entire patent system as an incentive to invest in those efforts and attempts which go by the name of 'research' " *In re Tomlinson*, 363 F.2d 928, 931, 150 U.S. P.Q. 623, 626 (Fed. Cir.

1966). In this connection, the Court has stated that "there is usually an element of 'obvious to try' in any research endeavor, that it is not undertaken with complete blindness but rather with some semblance of a chance of success." *Id.*

It is true that Appellants have been able to successfully employ a mask structure that contains a CVD organic layer comprising carbon and hydrogen, which is deposited by a plasma enhanced chemical vapor deposition process using a feed stream that comprises a hydrocarbon species. For instance, such layers have been shown to have the following characteristics: (a) they are conformal, allowing, for example, an extended etch of the layer after reaching the endpoint to be avoided (see paragraph [0036] of the present specification), (b) they are effective using fluorine-based chemistry (e.g., CF_4-based chemistry), which is, for example, a relatively clean chemistry (*Id.*); (c) they can be easily stripped in an oxygen-based plasma etching process (*Id.*); (d) they have a polycrystalline-silicon:CVD-organic selectivity that is greater than conventional dielectric hard masks, presently on the order of about 10:1 or greater, depending upon the etch recipe (*Id.* at paragraph [0035]); (e) they have k and n values which render them effective in combination with dielectric layers (e.g., a silicon oxynitride layer) (*Id.*); and (f) they can be readily etched using dielectric layers as masking layers (displaying, for example, a silicon-dioxide:CVD-organic selectivity of greater than about 100:1) (*Id.*). However, such successes cannot properly be used against the Applicant by the Office in establishing obviousness. In other words, the examiner's rejection relies on the use of undue and impermissible hindsight. See, merely for example, Akzo N.V. v. U.S. International Trade Commission, 808 F.2d1471, 1480-81, 1 USPQ2d 1241, 1246 (Fed. Cir. 1986), *cert. denied*, 482 U.S. 909 (1987), Loctite Corp. v. Ultraseal Ltd., 781 F.2d 861, 874, 228 USPQ 90, 99 (Fed. Cir. 1985). See also, MPEP 2142, second paragraph.

For the above reasons, it is respectfully submitted that independent claims 8, 17, 27 and 30 are each unobvious in view of Huang and Hasegawa.

Claims 9-11, 13, 15, 16, 18-21, 28 and 29 depend, either directly or indirectly from independent claims 8, 17 and 27 and are therefore patentable over Huang and Hasegawa for the same reasons.

B. <u>Rejection of Claims 22-24 under 35 U.S.C. 103(a)</u>

Claims 22-24 have been rejected under 35 U.S.C. 103(a) as unpatentable over Huang and Hasegawa and further in view of Tsai (U.S. Patent No. 6,083,815). Appellants believe this rejection to be unsustainable.

As noted above, claim 17 is patentable over Huang and Hasegawa, at least in that (a) there is no teaching, suggestion or motivation to use a "low dielectric layer" interlayer insulating layer as taught in Hasegawa et al. as an "organic material layer having low dielectric constant" masking layer as taught in Huang and (b) there would not be any expectation of success in doing so (e.g., the fact that a material may be useful as an interlayer insulating material within a multilayer interconnect structure would by no means provide a reasonable expectation that the same material can be successfully employed as a masking layer).

Tsai is cited by the examiner for its alleged teachings regarding "etching a substrate to form a gate stack in which the doped polysilicon layer includes a native oxide and etching the native oxide and the doped polysilicon layer using 2 plasma etching processes that comprise halogen containing species to form a gate stack." These teachings, however, do not make up for the above noted deficiencies in Huang and Hasegawa. For at least these reasons, it is respectfully submitted that independent claim 17 is patentable over Huang and Hasegawa in view of Tsai.

Claims 22-24 depend indirectly from independent claim 17 and are therefore patentable over Huang and Hasegawa in view of Tsai for at least the same reasons. Also, the combination of more references is further indicative of the use of undue hindsight discussed above.

C. <u>Rejection of Claims 25 and 26 under 35 U.S.C. 103(a)</u>

Claims 25 and 26 are rejected under 35 U.S.C. 103(a) as unpatentable over Huang and Hasegawa and further in view of Lou (U.S. Patent No.6,200,881). Appellants believe this rejection to also be unsustainable.

As noted above, claim 17 is patentable over Huang and Hasegawa, at least in that (a) there is no teaching, suggestion or motivation to use a "low dielectric layer" interlayer insulating layer as taught in Hasegawa et al. as an "organic material layer having low dielectric constant" masking layer as taught in Huang and (b) there would not be any expectation of success in doing so.

Lou is cited by the examiner for its alleged teachings regarding "a method for etching a substrate which comprises a silicon layer, an oxide layer over the silicon layer, and a silicon nitride layer over the oxide layer, wherein the silicon, oxide and nitride layers are etched by one or more plasma etching steps comprising oxygen and halogen containing species." These teachings, however, do not make up for the above noted deficiencies in Huang and Hasegawa. For at least these reasons, it is respectfully submitted that independent claim 17 is patentable over Huang and Hasegawa in view of Lou.

Claims 25 and 26 depend, either directly or indirectly from independent claim 17 and are therefore patentable over Huang and Hasegawa in view of Lou for at least the same reasons. Again, the combination of a larger number of references increases the inference of undue hindsight.

D. Rejection of Claims 30, 31, 33 and 34 under 35 U.S.C. 103(a)

Claims 30, 31, 33 and 34 are rejected under 35 U.S.C. 103(a) as unpatentable over Huang and Hasegawa and further in view of Chapman (U.S. Patent No. 5,976,769). Applicants respectfully submit that this rejection is also unsustainable.

As noted above claim 30 is patentable over Huang and Hasegawa, at least in that (a) there is no teaching, suggestion or motivation to use a "low dielectric layer" interlayer insulating layer as taught in Hasegawa et al. as an "organic material layer having low dielectric constant" masking layer as taught in Huang and (b) there would not be any expectation of success in doing so.

Chapman is cited by the examiner for its alleged teachings regarding "a method for providing sublithographic patterns wherein the exposed sidewalls of the organic layer are etched such that the width of the organic layer is reduced at the substrate using

etching techniques including plasma etch." These teachings, however, do not make up for the above noted deficiencies in Huang and Hasegawa. For at least these reasons, it is respectfully submitted that independent claim 30 is patentable over Huang and Hasegawa in view of Chapman.

Claims 31, 33 and 34 depend, either directly or indirectly from independent claim 30 and are therefore patentable over Huang and Hasegawa in view of Chapman for at least the same reasons. Here as well, the combination of more references increases the likelihood of undue hindsight.

E. Rejection of Claims 14, 32 and 35-40 under 35 U.S.C. 103(a)

Claims 14, 32 and 35-40 are rejected under 35 U.S.C. 103(a) as unpatentable over Huang and Hasegawa, and further in view of Cheng (U.S. Patent No. 5,873,984) or as unpatentable over Huang, Hasegawa and Chapman, and further in view of Cheng. Applicants believe that these rejections are also unsustainable.

As noted above, claims 8, 17, 27 and 30 are patentable over Huang, Hasegawa and Chapman, at least in that (a) there is no teaching, suggestion or motivation to use a "low dielectric layer" interlayer insulating layer as taught in Hasegawa et al. as an "organic material layer having low dielectric constant" masking layer as taught in Huang and (b) there would not be any expectation of success in doing so.

Cheng is cited by the examiner for its alleged teachings regarding an amorphous carbon layer containing carbon, carbon and nitrogen. These teachings, however, do not make up for the above noted deficiencies in Huang, Hasegawa and Chapman. Indeed, Cheng further supports the assertion made above that the Office Action is using the information vacuum in Huang as motivation to use *any* organic layer having low dielectric constant, which is formed using *any* technique, for *any* purpose. For example, it is noted that Cheng describes the formation of an amorphous carbon overcoat *by sputtering* for use as a *protective film* on a *magnetic recording disk*. See, e.g. Title and Abstract. Hence, Cheng has nothing to do with masking layers as presently claimed.

For at least these reasons, it is respectfully submitted that independent claims 8, 17, 27 and 30 are patentable over Huang, Hasegawa and Chapman in view of Cheng.

Claims 14, 32 and 35-40 depend, either directly or indirectly from independent claim 8, 17, 27 or 30 and are therefore patentable over Huang, Hasegawa and Chapman in view of Cheng for at least the same reasons.

IX. CONCLUSION

The references relied on by the examiner do not support a *prima facie* case of obviousness. For the foregoing reasons, it is respectfully submitted that reversal of the examiner's rejection of all of the claims is in order

X. FEES

The Office is authorized to charge any fees due and owing in respect to the filing of this paper to deposit account number 50-1047.

Respectfully submitted,

David B. Bonham Reg. No. 34,297

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APPENDIX

Claims 1-7 (cancelled).

8. (Previously presented) A method of forming a multilayer antireflective hard mask structure, said method comprising:

providing a substrate structure;

depositing a CVD organic layer over said substrate structure by a plasma enhanced chemical vapor deposition process using a feed stream that comprises a hydrocarbon species, said CVD organic layer comprising carbon and hydrogen;

depositing a dielectric layer over said CVD organic layer;

providing a patterned organic photoresist layer over said dielectric layer;

etching said dielectric layer through apertures in said patterned photoresist layer in a first plasma etching step until apertures are formed in said dielectric layer; and

etching said CVD organic layer through said apertures in said dielectric layer in a second plasma etching step until apertures are formed in said CVD organic layer.

9. (Original) The method of claim 8, wherein said dielectric layer is a silicon oxynitride layer.

10. (Original) The method of claim 9, wherein said first plasma etching step is conducted using a plasma source gas that comprises a halogen containing species.

11. (Original) The method of claim 10, wherein said first plasma etching step is conducted using a plasma source gas that comprises a fluorocarbon containing species.

12. (Cancelled)

13. (Previously presented) The method of claim 1, wherein said hydrocarbon species is propylene gas.

14. (Previously presented) The method of claim 1, wherein said feed stream further comprises N_2 gas.

15. (Original) The method of claim 8, wherein said second plasma etching step is conducted using a plasma source gas that comprises an oxygen containing species.

16. (Original) The method of claim 15, wherein said oxygen containing species is O_2.

17. (Previously presented) A method of etching a substrate structure comprising:

providing a substrate structure;

providing a patterned multilayer mask structure over said substrate structure, said patterned multilayer mask structure having apertures and comprising: (a) a CVD organic layer comprising carbon and hydrogen deposited over said substrate structure by a plasma enhanced chemical vapor deposition process using a feed stream that comprises a hydrocarbon species and (b) a dielectric layer over said CVD organic layer; and

etching said substrate structure through said apertures by a plasma etching process.

18. (Original) The method of claim 17, further comprising removing remnants of said CVD organic layer after said substrate structure is etched.

19. (Original) The method of claim 18, wherein said remnants are removed by a plasma etching process in the presence of a plasma source gas that comprises an oxygen containing species.

20. (Original) The method of claim 19, wherein said oxygen containing species is O_2.

21. (Original) The method of claim 17, wherein said substrate structure comprises a silicon layer and wherein said silicon layer is etched in the course of said plasma etching process.

22. (Original) The method of claim 21, wherein said plasma etching process comprises a plasma etching step that utilizes a plasma source gas composition comprising a halogen containing species.

23. (Original) The method of claim 21,

wherein said substrate structure comprises a single crystal silicon layer, an oxide layer over said single crystal silicon layer, a doped polycrystalline silicon layer over said oxide layer and a native oxide layer over said doped polycrystalline silicon layer, and

wherein said native oxide layer and said doped polycrystalline silicon layer are etched by said plasma etching process.

24. (Original) The method of claim 23, wherein said plasma etching process comprises two or more plasma etching steps and wherein each of the two or more plasma etching steps utilizes a plasma source gas composition that comprises a halogen containing species.

25. (Original) The method of claim 21, wherein said substrate structure comprises a single crystal silicon layer, an oxide layer over said single crystal silicon layer and a silicon nitride layer over said oxide layer, and

wherein said single crystal silicon layer, said oxide layer, and said silicon nitride layer are etched by said plasma etching process.

26. (Previously presented) The method of claim 25, wherein said plasma etching process comprises (a) one or more plasma etching steps that utilize a plasma source gas composition comprising an oxygen containing species and (b) one or more plasma etching steps that utilize a plasma source gas composition comprising a halogen containing species.

27. (Previously presented) A method of etching a substrate structure comprising:

providing a substrate structure;

providing a CVD organic layer comprising carbon and hydrogen over said substrate structure by a plasma enhanced chemical vapor deposition process using a feed stream that comprises a hydrocarbon species, said CVD organic layer having apertures therein; and

etching said substrate structure through said apertures by a plasma etching process.

28. (Original) The method of claim 27, further comprising removing remnants of said CVD organic layer after said substrate structure is etched by a plasma etching process in the presence of a plasma source gas that comprises an oxygen containing species.

29. (Original) The method of claim 28, wherein said oxygen containing species is O_2.

30. (Previously presented) A method for trimming a mask feature comprising:

providing one or more mask features on a substrate structure, each said mask feature comprising (a) a CVD organic layer comprising carbon and hydrogen deposited on said substrate structure by a plasma enhanced chemical vapor deposition process using a feed stream that comprises a hydrocarbon species, and (b) a dielectric layer disposed over said CVD organic layer such that sidewall portions of said CVD organic layer are exposed; and

etching said exposed sidewall portions of said CVD organic layer by means of a plasma etching process such that the width of said one or more mask features is reduced at said substrate.

31. (Original) The method of claim 30, wherein said dielectric layer is a silicon oxynitride layer.

32. (Original) The method of claim 30, wherein said CVD organic layer comprises 70-80 % carbon, 10-20% hydrogen and 5-15% nitrogen.

33. (Original) The method of claim 30, wherein said CVD organic layer is etched using a plasma source gas that comprises an oxygen containing species.

34. (Original) The method of claim 33, wherein said oxygen containing species is O_2.

35. (Previously presented) The method of claim 8, wherein said CVD organic layer comprises 70-80 % carbon, 10-20% hydrogen and 5-15% nitrogen.

36. (Previously presented) The method of claim 8, wherein said dielectric layer is a silicon oxynitride layer and wherein said CVD organic layer comprises 70-80% carbon, 10-20% hydrogen and 5-15% nitrogen.

37. (Previously presented) The method of claim 17, wherein said CVD organic layer comprises 70-80 % carbon, 10-20% hydrogen and 5-15% nitrogen.

38. (Previously presented) The method of claim 17, wherein said dielectric layer is a silicon oxynitride layer and wherein said CVD organic layer comprises 70-80% carbon, 10-20% hydrogen and 5-15% nitrogen.

39. (Previously presented) The method of claim 27, wherein said CVD organic layer comprises 70-80 % carbon, 10-20% hydrogen and 5-15% nitrogen.

40. (Previously presented) The method of claim 30, wherein said dielectric layer is a silicon oxynitride layer and wherein said CVD organic layer comprises 70-80% carbon, 10-20% hydrogen and 5-15% nitrogen.